HEAT, CORROSION, AND WEAR RESISTANT STEEL ALLOY

This is a continuation of application Ser. No. 07/168,924 filed Mar. 16, 1988, now U.S. Pat. No. 4,929,419.

BACKGROUND OF THE INVENTION

This invention relates to an austenitic, corrosion resistant steel alloy and in particular to such an alloy and articles made therefrom having good high temperature strength in combination with good wear resistance.

Efforts to improve the performance and durability of internal combustion engines have resulted in a demand for materials which can withstand the corrosive, high temperature, and high stress conditions of such engines. Of the many components which make up modern day gasoline and diesel engines, the exhaust valves are subjected to all of the foregoing conditions when in use. Among the properties desired of materials for fabricating exhaust valves for high performance, heavy duty, internal combustion engines are good high temperature strength and hardness, resistance to oxidation and hot corrosion, good wear resistance and good formability.

U.S. Pat. No. 3,969,109 granted July 12, 1976 to H. Tanczyn relates to an austenitic stainless steel having the following composition in weight percent (w/o). Here and throughout this application, percent will be by weight unless otherwise indicated.

Element	w/o
C	0.20–0.50
Mn	0.01–3.0
Si	2 max.
P	0.10 max.
S	0.40 max.
Cr	18–35
Ni	0.01–15
N	0.30–1.0
Fe	Balance

Included with the balance are the usual incidental amounts of other elements present in commercial grades of such steels. Tanczyn also suggests that up to 4 w/o molybdenum, or up to 3% tungsten can be added to the alloy. Tanczyn further states that columbium and/or vanadium may be added to the alloy in amounts up to 2% total The alloy which is described in the Tanczyn patent has been used to make exhaust valves for high performance, heavy duty automotive engines.

An alloy designated as "23-8N" has been sold containing about 0.28–0.38% C, 1.5–3.5% Mn, 0.5–1.0% Si, 0.04% max. P, 0.03% max. S, 22.0–24.0% Cr, 7.0–9.0% Ni, 0.25–0.40% N, and the balance of essentially iron. "23-8N" alloy leaves something to be desired, however, with respect to wear resistance. Under severe service conditions, exhaust valves formed from the 23-8N alloy are subject to undesirable wear due to the metal-to-metal contact between the valve head and seat unless hard faced to obtain better wear resistance.

U.S. Pat. No. 3,561,953, granted Feb. 9, 1971 to I. Niimi et al. relates to an austenitic steel alloy containing nickel, chromium, manganese, molybdenum and vanadium. The broad range of the alloy described in Niimi et al. is as follows:

Element	w/o
C	0.1–0.6
Mn	3.0–15.0
Si	0.1–2.0
Cr	15.0–28.0
Ni	1.0–15.0
Mo	0.01–1.5
V	0.01–1.5
N	0.2–0.6
W	0.01–2.0
Cb	0.01–1.5
Ca	0.001–0.020
O	<0.008
Fe	Balance

The balance includes usual amounts of incidental elements present in commercial grades of such steels. Niimi et al states that the alloy is "for engine valves and similar applications". However, Niimi et al. does not address the problem of adhesive wear resistance in automotive exhaust valves. Furthermore, Niimi et al. states that Y and Mo adversely affect the hot workability of the alloy. Niimi et al. is directed to an alloy in which oxygen content is severely limited and which relies on the use of a small amount of calcium to improve the hot workability of the alloy.

U.S. Pat. No. 3,366,472 granted on Jan. 30, 1968 to H. Tanczyn et al. relates to an austenitic stainless steel alloy containing chromium, nickel, manganese, vanadium, carbon and nitrogen. The broad compositional range of the alloy described in Tanczyn et al. is as follows:

Element	w/o Range
C	0.20–1.50
Mn	0.01–16.00
Si	1.25 max.
P	0.050 max.
S	0.35 max.
Cr	12–30
Ni	0.01–7
Mo	4.00 max.
V	0.50–2.00
N	0.15–0.75
B	Up to 0.005
W	4.00 max.
Cb	1.50 max.
Cu	4.00 max.
Fe	Balance

and in which the sum of w/o nickel and w/o manganese must be at least 6%. Included with the balance are the usual amounts of other elements present in commercial grades of such steels. The alloy described in the Tanczyn et al. patent is indicated as being heat hardenable and to have high strength at both room and elevated temperatures in both the solution treated and age-hardened condition, although only room temperature strength is indicated. However, the alloy of Tanczyn et al. is believed to provide less than desirable hardness and wear resistance at elevated temperatures.

SUMMARY OF THE INVENTION

In accordance with this invention, a precipitation strengthenable, austenitic steel alloy and article made therefrom, are provided having mechanical properties and corrosion resistance properties comparable to 23-8N but with improved heat resistance and elevated temperature wear resistance. The alloy of this invention consists essentially of, in weight percent, about: